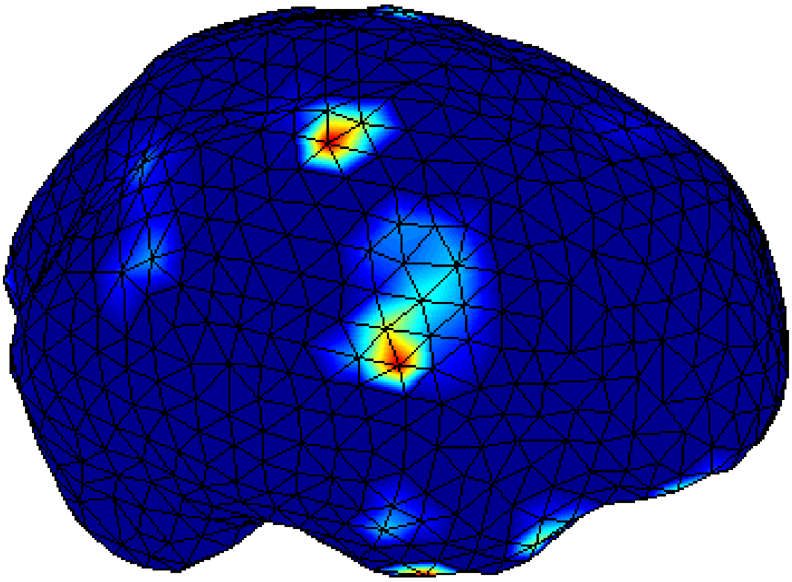
Elekta Neuromag

MCE User's Guide

Version 1.3

May 2004



ELEKTA

Copyright and Warranty

This program was developed at the Brain Research Unit of the Low Temperature Laboratory in Helsinki University of Technology.

The commercial distribution of the product for MEG analysis is exclusively licensed to Elekta Neuromag Oy.

Included with the software are public domain software components:

- mysql_mex by Kimmo Uutela
- lpsolve_mex by Kimmo Uutela, Michel Berkelaar, and Jeroen Dirks
- Perl 5 by Larry Wall
- DBI by Tim Bunce
- DBD:mysql by Perl Jochen Wiedmann
- Berkeley MPEG Tools by The Regents of the University of California

See the source code of these programs provided with the software for copyright details those components.

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1 Introduction

This manual describes the use of MCE program to analyze magnetoencephalographic (MEG) measurements using L1 minimum norm estimates[1,2] (L1 MNE).

1.1 Hazard Information

This manual contains important hazard information which must be read, understood and observed by all users, For your convenience all warnings that appear in the manual are presented below.

Warning: Like all inverse solutions of MEG, MCE provides a source distribution which is one of infinitely many different possible ones. The results must be interpreted and reviewed by a person having good understanding of the capabilities and limitations of the methods being used.

Warning: This program should only be used with hardware and software given in the specifications listed in the Release Notes of the release being used.

Warning: On some platforms other programs can affect the colors in the windows of the MCE program. In such cases other programs using colored windows should be stopped to ensure correct colors on the displays.

Warning: The triangle meshes used in MCE to describe the shape of the brain must be defined in head coordinates. This differs from the recommended coordinate system usage in dipole modeling program.

Warning: If the regularization parameters are changed from the default ones, the new values must be validated using known data.

Warning: Region of interest may contain multiple sources whose activities are mixed together.

Warning: All users that have access to the database can also access the database entries related to the data of other users.

1.2 Version

This manual refers to program version 1.3 patch level 18 and later.

1.3 What's new?

- Default directory menu
- Export figure menu
- Batch calculation error log display
- Slowed down animation
- Calculation can be cancelled
- Showing selected ROI in arrow display
- Show subject ID & file name in different figures
- Added several warnings to the manual

1.4 Conventions and typography

Buttons that can be pressed will be shown in square brackets: [Button]

Text written by the user is shown as

```
User input
```

Some important warnings are shown in **bold**.

1.5 References

1. K. Matsuura and U. Okabe, "Selective minimum-norm solution of the biomagnetic inverse problem", *IEEE Trans. Biomed. Eng.* 42:608-615, 1995.
2. K. Uutela, M. Hämäläinen, and E. Somersalo, "Visualization of Magnetoencephalographic Data using Minimum Current Estimates", *NeuroImage*, 1999. In press.

2 Getting Started

To start the program, double click the MCE icon in the Neuromag folder of the Application manager. **An iconified Matlab console appears on the desktop; do not close it!** Also the main window shown in Figure 1 opens.

If you are using a previously calculated response, you should now load an old calculation (p. 12). Otherwise, you should select a data file using the [File] button and select the head model (p. 8). The main window is described in more detail on page 22.

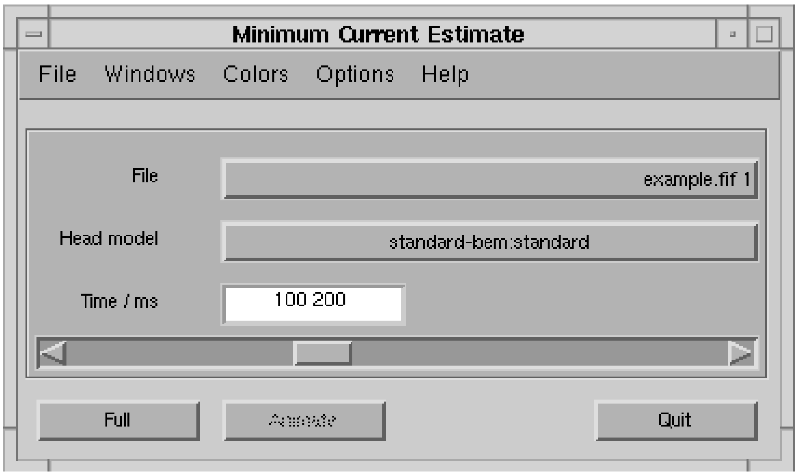


Figure 1 The main window

2.1 Analyzing data

To analyze your data with the L1 MNE, first you should calculate the estimates:

1. Load and pre-process the MEG data (p. 4)
2. Select the head model (p. 8)
3. Start the calculation (p. 11)

After you have loaded (p. 12) the calculated estimates, you can proceed by viewing the results (p. 33) at different times (p. 13) or by studying the temporal activity of the Regions of Interest (p. 14).

2.2 Quitting the program

You can quit the program by three alternative ways:

1. pressing the [Quit] button in the Main window
2. typing "quit" Matlab command in the terminal window
3. by closing the main window.

3 Selecting the data file and pre-processing

Select the MEG data file by pressing the [File] button of main window (p. 22). Select the data file from the dialog. If the file has several data sets, a selection dialog pops up and you can select the correct data set.

When the you have selected the data, the pre-processing dialog (see Figure 2) will open.

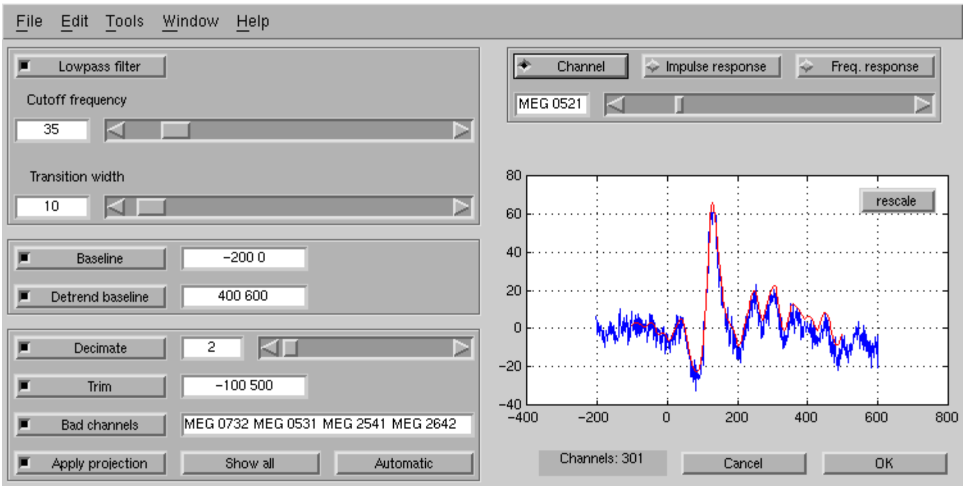


Figure 2   The pre-processing dialog

3.1 Setting the filtering and baselines

Because the MEG signals are mainly concentrated to the lower frequencies, you can increase the signal-to-noise ratio with an low-pass filter. Select the [Lowpass filter] toggle and set appropriate cutoff frequency and transition width of the filter. After changing the numeric values, press Enter or the Tab key to update the value. You can view the effect on a single channel by pressing the [Channel] toggle or the filter response with the [Impulse response] and [Freq. response] buttons. You can zoom into the preview window with the left mouse button and revert to automatic scaling with the [rescale] button.

Because most of the channels usually have a non-zero DC-level, you should select a [Baseline] toggle and select a time period where there should be no real evoked responses, typically before the stimulus.

If you are analyzing a long period or the data otherwise includes strong artificial slow drifts, you can select a [Detrend baseline] period after the evoked response. This is usually a safer way of getting rid of the drifts than, for example, applying high-pass filter.

The de-trend baseline actually fits a line to the values in the two baselines and subtracts it form the data (see Figure 3).

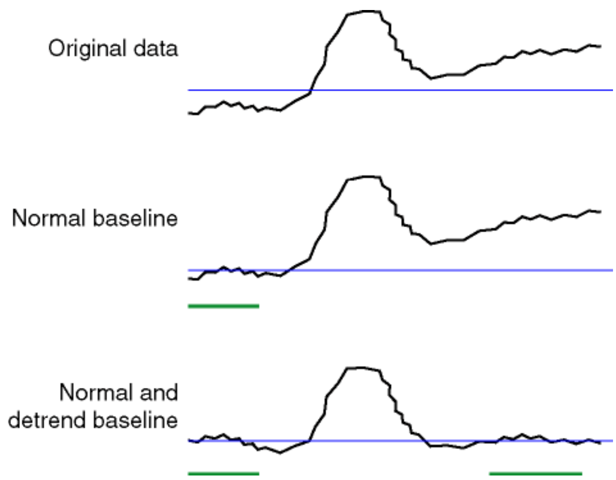


Figure 3 Effect of the baselines

3.2 Decreasing the computing time and file sizes

If you do not calculate estimates at all the time points, you can decrease the computing time and save disk space.

If you low-pass filter the data, the data will be smoother and it is unnecessary to calculate the estimate at each time point. By selecting a down-sampling ratio with the [Decimate] toggle and slider, the estimates will be calculated with constant intervals.

You can select the correct amount of down-sampling by selecting the [Freq. response] button. If the down-sampling is too strong compared to the filter pass-band, the higher frequencies will be mapped to the lower frequencies (see Figure 4). A reasonable down-sampling ratio is the one, for example, having the cutoff frequency about half way between the zero frequency and the highest shown frequency. The down-sampling is carried out by selecting single data points of the filtered response.

If you do not need to analyze the whole epoch, select the interesting time period with the [Trim] toggle button and text fields.

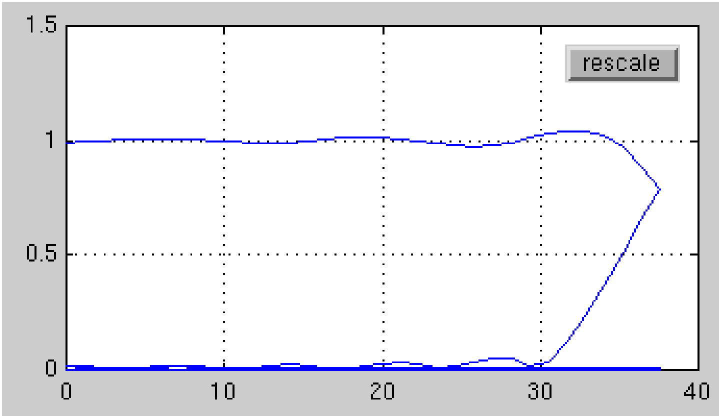


Figure 4 If too strong down-sampling is applied, the aliasing is reflected in the preview window with the folding frequency response. Decrease the filter cutoff frequency or decimation.

3.3 Bad channels and projections

If some of the channels are flat or bad, you must set the [Bad channels] toggle and write the channel names to the corresponding text field. The format can be "`MEG 1112 1113` ..." or "`MEG 1112 MEG 1113` ...", the channels described with four digits for Elekta Neuromag™ or Vectorview™ data and three digits for Neuromag-122™ data. Use the numbers in the channel names regardless of the channel order in the fif-file. Wildcards are not supported.

External disturbance fields can be filtered using Signal Space Projection (SSP). If the fif-datafile has a noise projection specified, you can apply it to the data and calculations by selecting the [Apply projection] toggle. The projection is updated when you change the bad channels. Normal data files where the projection information is included and the data itself is the original non-projected data should be used. If projected data is used, the file must also contain the projection vectors that were used define the removed subspace. Otherwise the results may be distorted.

When you load a new file or press the [Automatic] button, the bad channels are set automatically. The following channels are set bad:

1. Channels that are marked bad in the fif-file
2. If baseline is used, the channels where the baseline is flat
3. If baseline is used, the channels where the baseline is very noisy

The "flat channels" are the ones where the standard deviation of the raw baseline activity is less than 10 % of the median value of others. The "noisy channels" are the ones where the standard deviation of the baseline activity after projections is over three times the median value. If the data includes both gradiometer and magnetometer data, the values are only compared with the channels with same coil type.

In practice, you should first specify the baseline period and then press the [Automatic] button, and then add bad channels that are not included. Because the selection of the bad channels slightly affects the projections and the projections affect the selection of the noisy channels, resetting the projections repeatedly may result in different channels being marked bad at the second time, if their noise levels are near the limits.

A handy way of screening for possible bad channels is to open the MEG Data dialog (p. 26) by pressing the [Show all] button. All the channels will be shown, overlaid based on the location. If one of the waveforms seems to be an outlier, right-click it at the time of the maximum difference, and the channel ID is shown.

4 Selecting the head model

You can select the head model by pressing the [Head model] button in the Main window (p. 22). The head model consists of two parts: the boundary element model (BEM) (p. 8) describes the shape of the brain and the point set (p. 9) describes the parameters needed in the calculation. First, the BEM model selection window opens up.

4.1 BEM selection

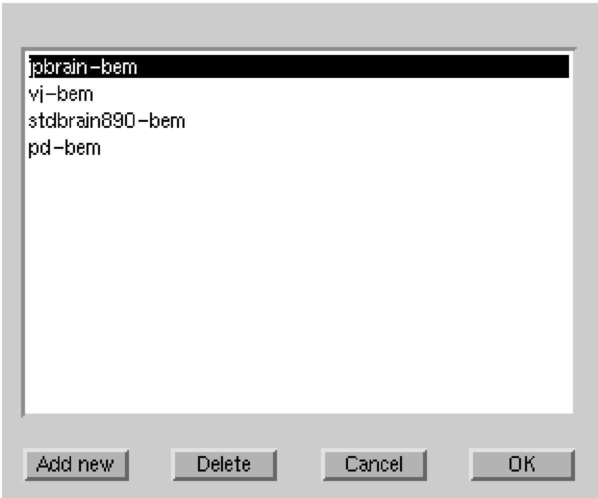


Figure 5 BEM model selection dialog

The boundary element model (BEM) describes the shape of the brain. In the current version (1.3), only sphere models are used in the forward calculation, but the BEM model affects the point set used in the calculation and the images used in the 3D visualization.

The BEM dialog shows a list of existing models associated with the same subject and some general models. You can select an existing model from the list and accept it by pressing the [OK] button.

You can add a new BEM model by pressing the [Add new] button. A file selection box for selecting the fif-file opens up, and after the selection you can select the associated the subject.

If the BEM model is not used by any point set (p. 9), you can delete it by pressing the [Delete] button. If it is used by point sets, you should first delete the point sets.

After you have accepted the BEM model by pressing the [OK] button, you should select the point set.

4.2 Point set selection

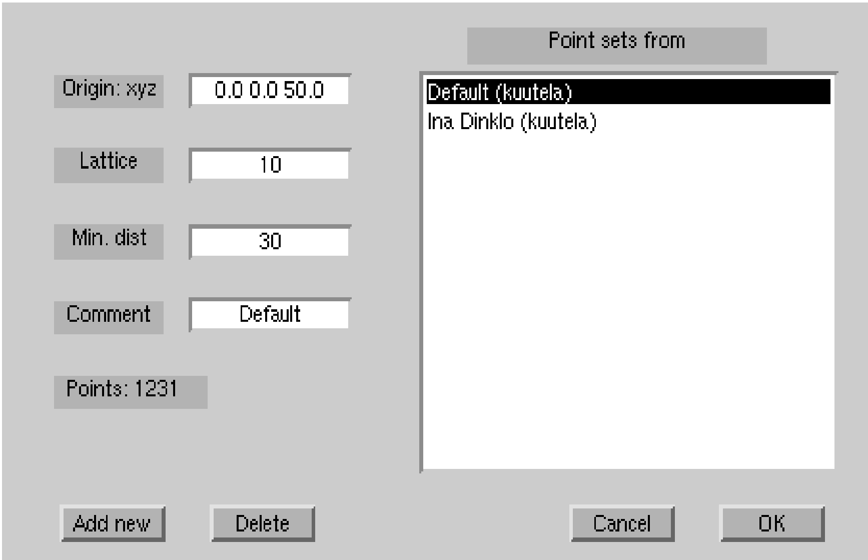


Figure 6 Point set selection dialog

The point set includes the brain locations that are used as a source space in the calculations and the parameters of the conductor model used in the forward calculations. Each point set is related with a certain BEM model (p. 8) and a certain subject.

From the Point set dialog you can select an existing set from the list and accept it by pressing the [OK] button. After this you can proceed by making the full calculation (p. 11).

You can create a new point set by pressing the [Add new] button and setting appropriate values to the properties of the point set. If you modify the Origin, Lattice, or Min dist properties, the point set is recalculated and the number of points is show. If you accept the new point set by pressing the OK button, it will take a while to calculate the projection from the point set to the BEM. You can remove the point sets by pressing the [Delete] button. If several people are using the point set, it will be deleted only when it is deleted by all its users.

Table 1 Properties of the point sets

Origin: xyz	Sphere model origin (in mm; head coordinates)
Lattice	The density of the points in the point set (in mm)
Min dist	The minimum distance to the sphere model origin (in mm). Points deeper than this are excluded from the point set. Very deep source points may lead to numerical instability in the calculations.
Comment	The comment seen in the list
Points	The number of possible source points

4.3 Creating BEM files

If you have MR images of the subject, you can create fif-files describing boundary element models of the brain with MriLab and meshes2fiff programs. See the manuals of those programs (or Source Modeling manual) for details of using those programs.

When creating the meshes in Mrilab, you must save them in head coordinates in meters.

⚠ **Warning:** The triangle meshes used in MCE to describe the shape of the brain must be defined in head coordinates. This differs from the recommended coordinate system usage in dipole modeling program.

5 Calculating the estimates

Before viewing the results you have to calculate the current estimates for the epoch.

You should have already selected the MEG data, pre-processed it, and selected the head model (see chapters “Selecting the data file and pre-processing” on page 4 and “Selecting the head model” on page 8). If the noise level of the measurement is very high or low, you might change the regularization level or if either magnetometers or gradiometers are especially noisy their relative noise levels (p. 22).

Add the current data set by pressing the [Full] button in the main window (p. 22). The full calculation dialog opens up. Check that the [Calculate] button is pressed and press the [OK] to add the new batch job.

Now the batch jobs window (p. 28) opens up. The job you just created is in the list in the `wait` state. The preferred way of calculating the estimates is to press the [Start server] button. This will start the calculation in the background. The server selects the job whose priority order is smallest and calculates the estimate. When it has finished, it saves the results to a file with name like `filename#_full.mat`, where `filename` is the name of the data file and # is the number of the data set, selects a new job and continues calculating that. When there are no more jobs waiting, the server quits.

Note: The server uses a separate Matlab program which may require an additional Matlab license to run.

If there is an error in the calculation, the job is left on the list, but its state changes to `err`. This may happen, for example, if the computer where the server runs can not access the data files. When the server quits, it writes a log file. You can view the latest error log file created by the server with the [Error log] button. You calculate the estimate by resetting the job (p. 28) and starting a new server in a computer that can access the data file. You can have only one server in one computer. You can start the calculation server in other computers also by giving the UNIX command

```
/neuro/mce/settings/l1calc
```

When the server is running, you can use the main program to add new jobs or view the results, or even quit the program and free the terminal for others.After the estimate has been calculated, you should load it with the [Full] button.

Another method to start the calculation is to select one particular job and press the [Calculate] button. You will see the progress bars, but you can not use the program for other tasks, and quitting the application cancels the calculation. You can also cancel the calculation by pressing any button in the Batch calculation window. In this case the calculated estimate is loaded automatically. The error log is not updated; instead, the possible error messages are shown in the Matlab command window.

6 Loading a calculated estimate

If you have previously calculated (p. 11) an estimate and saved it to a disk file, you can load it by pressing the [Full] button in the Main window (p. 22) to open the full calculation dialog (p. 27).

If you have selected the right fif-file and have previously saved the corresponding estimate with the default name, the default values in the dialog should be set to load the estimate.

Otherwise, check that the [Load] button in the Full calculation dialog (p. 27) is pressed and select the estimate with the [Select file...] button.

When you press the [OK] button, the batch calculation and its parameters are loaded.

The program can also load estimates calculated previous versions of the program, but some features are not available. For example, the subject ID may be incorrect.

7 Selecting the time

You can select a single time point in three ways:

- By entering the time (in ms) in the [Time] field in the Main window (p. 22).
- By using the slider in the Main window (p. 22).
- By pressing the left mouse button in the Amplitude window (p. 31), if a batch calculation is loaded.

However, because the single estimates are usually noisy, it is usually more fruitful to view the average activity within a time range. You can also select the range in three ways:

- By entering the start and end time (in ms) in the [Time] field in the Main window
- By pressing the and dragging with the right mouse button in the Amplitude window (p. 31)
- By giving in the Matlab terminal window command

```
startl1('span',tmin:tmax)
```

where `tmin` and `tmin` are the start and end times in milliseconds. For example, to select time span between 100 and 200 milliseconds, use

```
startl1('span',100:200)
```

8 Region of interest

You can estimate the activity in certain brain area as a function of time by defining a region of interest (ROI). ROI is actually a weighting function that is used to calculate the sum amplitude from the estimate.

8.1 What is ROI?

The smoothed weighting is a function of position $\bar{r}$, having form

$$f(\bar{r}) = e^{-\bar{r}^T W \bar{r}}$$

but you don't need to be interested in matrix calculation to understand how the ROIs work.

The ROI window (p. 34) visualizes the currently selected ROI with an ellipsoid. The weight in the center has weight 1 in the sum, and the points on border of the ellipsoid have the weight 0.60.

Activity at each source location is multiplied with the corresponding weight and added together. The weighted sum is shown in the Amplitude window (p. 31).

A ROI can also have hard edges. In this case, the weight is

$$f(\bar{r}) = 1 \text{, if } -\bar{r}^T W \bar{r} < 1 \text{, otherwise 0.}$$

If no ROI is selected, normal sum of all the activity is used.

8.2 What is the orientation of a ROI?

Since MEG is sensitive to the orientation of the neural currents and this information is often very useful in differentiating nearby source areas, the ROIs can be used with a defined orientation. The weighting function depends in this case also on the orientation $\bar{q}_0$ and the direction of the estimated current $\bar{q}$:

$$g(\bar{r}, \bar{q}) = f(\bar{r})\frac{\bar{q} \cdot \bar{q}_0}{\|\bar{q}\|\|\bar{q}_0\|}$$

The amplitude is the projection of the estimated current on the selected orientation. If the estimated current is parallel with the ROI, the amplitude will be the same as for the non-oriented ROI. If the orientation is opposite, the amplitude will be negative. You can select to use either the oriented or non-oriented ROI with the Amplitude scale window (p. 32).

8.3 Selecting a ROI

You can select a ROI from the Color display (p. 29). Select a range of nodes with the right mouse button.

The program will find the active source points that are contributing to the selected activity and calculate the ROI center and extent. The orientation of the ROI will be the mean orientation of selected currents.

After selecting a new ROI, activity weighted with it is shown in the ROI window (p. 34), the time course of activity in the area is shown in the Amplitude window (p. 31), and the parameters of the ROI are shown in the ROI database (p. 35). In the Color display or Arrow display (p. 30) you can toggle between showing the selected activity and all the activity by pressing any key when the window is selected.

Warning: Region of interest may contain multiple sources whose activities are mixed together.

8.4 ROI database

You can compare the activity of a certain brain area in different measurements and subjects by saving the ROIs in a database.

You can access the database with the ROI database window (p. 35). When you have selected the ROI corresponding to the interesting brain area, write the name of the area in the [Comment] field and press the [Save] button.

If you want to see the activity of the same area during another measurement, load (p. 12) the corresponding estimate, press down the [Show other files] button, and select the area from the list.

If you compare the results of different subjects and possibly with your colleagues, you may need to press down the [Show other subjects] button or change the user name in the [Creator] field. If there is a huge number of ROIs in the database, you can constrain the search using SQL search (p. 37).

8.5 Exporting ROIs

You can export the ROI ellipsoids to Mrilab with the [Export new file] and [Append] commands in the [Options] menu of the ROI database window (p. 38). The output files can be imported to Mrilab (see corresponding manual for details).

9 Predicting MEG waveforms

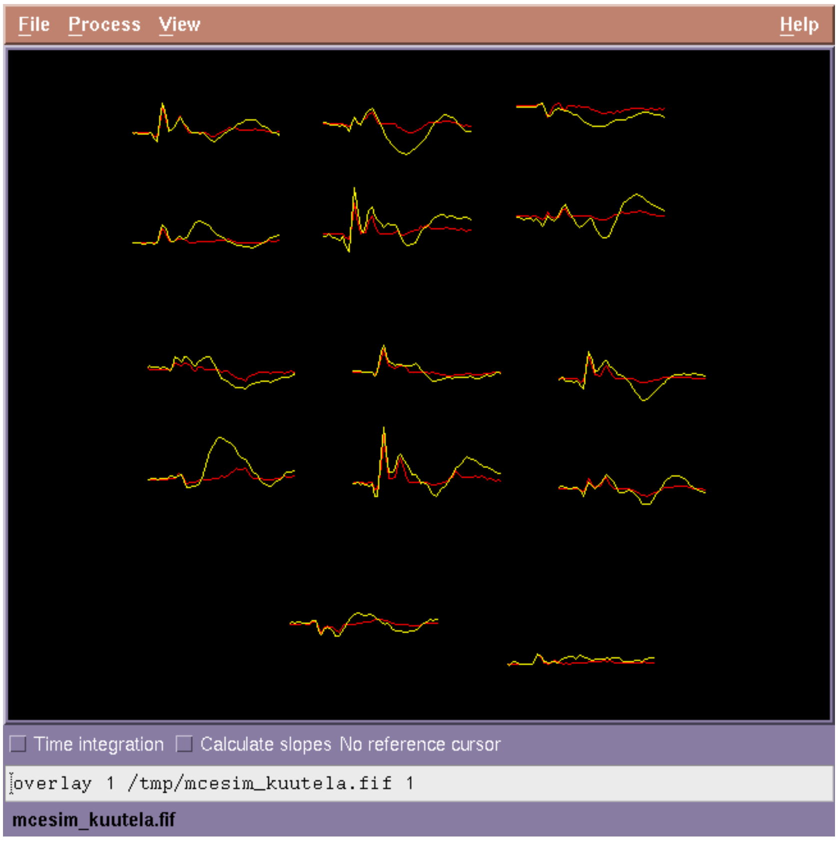


Figure 7 Predicted fields shown with XPlotter. The original measurement is shown with yellow lines and the waveforms predicted with the activity of the selected ROI is shown with red lines.

To find out, what part of the measured data is explained with the activity in the selected ROI, you can press the [Show predicted fields] command in the [Options] menu of the Amplitude window (p. 31). The program calculates the magnetic field produced by the currents in the selected ROI and shows them with the XPlotter program together with the original data loaded from the fif-file. If you select a new ROI, the waveforms are updated when you select the [Show predicted fields] button again.

10 Printing

You can print the displays or save them as images by using the printing dialog, or with UNIX command

```
/neuro/mce/bin/xgifdump
```

10.1 Printing from the dialog

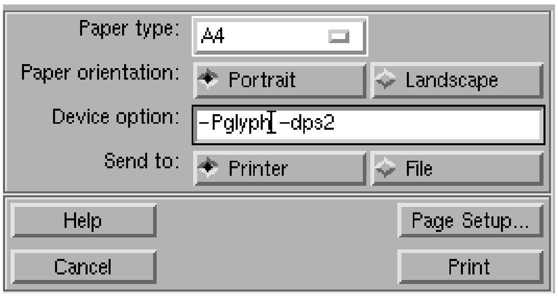


Figure 8 The printing dialog

The [Print] command in the File menu (p. 21) opens the printing dialog. Select the correct paper type and orientation, select the correct printer by typing

```
-Pprintername -dpsc2
```

in the [Device option] field and press the [Print] button.

10.2 Saving to an image file

The [Print] command in the File menu (p. 21) opens the printing dialog. You can save the image with a format compatible with old *Adobe Illustrator* by typing

```
-dill
```

in the [Device option] field, or as a general EPS-file (which can be opened in Adobe Illustrator version 6 or newer) with the option

```
-depsc
```

To produce JPEG output, use the option

```
-djpeg
```

Press down the [File] button, then the [Save...] button, and a dialog for the output file name is opened.

The EPS formats suit well the Arrow (p. 30), Amplitude (p. 31), and Region of interest (p. 34) windows. In the conversion of the color displays (Color display (p. 29), Color scale (p. 33)) some errors may occur; the JPEG or PNG formats are more suitable for them.

10.3 Saving with `xgifdump` command

The images can be saved in GIF format by giving the command

```
/neuro/mce/bin/xgifdump
```

in an UNIX terminal window.

The command will ask the name of the output file and to select the correct window with the mouse. A convenient way to save several images from the Color display (p. 29) is to create an HTML file (p. 19), which includes the images in PNG format.

11 Creating HTML documents and MPEG movies

11.1 Creating HTML documents

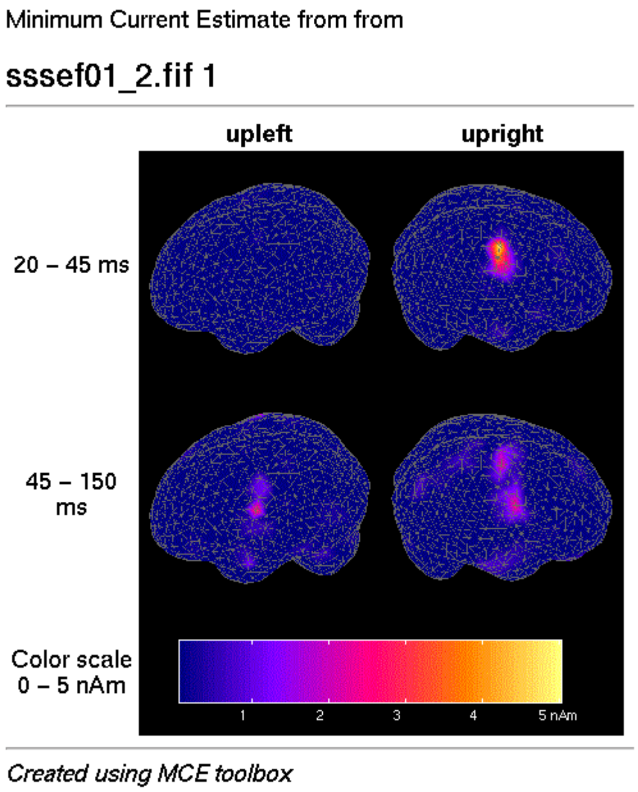


Figure 9 An example of a created HTML document

You can create HTML documents with the HTML document creation dialog (p. 38). The document will include projected, color coded views of the estimate from selected orientations and different time periods. The images in PNG (Portable Network Graphics) format are saved in the same folder as the HTML file, with names like `prefix_begintime_endtime_orientation.png`. You can view the results with typical HTML browsers, such as Netscape Navigator™ or Microsoft's Internet Explorer™.

Table 2 Default viewing orientations for created HTML documents MPEG movies

Orientation	Horizontal rotation	Elevation
left	-90	0
right	90	0
back	0	0
top	0	90
bottom	0	-90
front	180	0
upleft	-90	30
upright	90	30
leftback	-45	30
rightback	45	30

11.2 Creating movies

You can create MPEG movies with the Movie creation dialog (p. 39). The movie will show projected, color coded views of the estimate from the selected orientation. To smoothen the animation, each movie frame will represent the average activity during specified time window. If you want the best possible temporal resolution, set the window length to the frame skip length, otherwise use longer window lengths. You should be able to view the produced MPEG-1 movie with most common MPEG movie viewing programs. A public domain MPEG viewing program by The Regents of the University of California can be used with the UNIX command

```
/neuro/mce/bin/mpeg_play movie.mpeg
```

12 MCE windows and dialogs

12.1 Window menus

Figure 10 Menus of the Main Window (p. 22)

File

Create HTML ...	Opens the HTML creation dialog (p. 38)
Create movie ...	Opens the HTML creation dialog (p. 39)
Print...	Opens the print dialog (see Printing (p. 17))
Close	Closes the current window

Windows

Opens the different windows

Colors

Selects the color map for current window

Help

L1 MNE Help	Opens this manual in a Web browser
About L1 MNE	Shows the version

Options

Some windows have specific options.

12.2 Main window

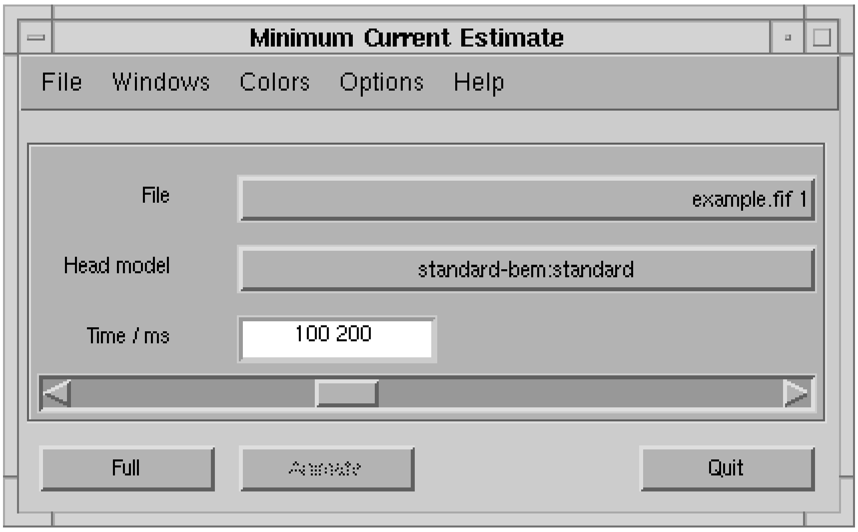


Figure 11 The main window

The main window is opened when the program starts, and closing it quits the program.

Table 3 Controls in the Main window

[File]	Select the name of the fif-file containing the response. Shows the name of the selected file. If a batch calculation is loaded, has the text `(full)` behind the file name.
[Head model]	Select the head model (p. 8). Shows the currently selected BEM (p. 8) and point set (p. 9).
[Time]	The slider and text field select and show the current time range (p. 13).
[Full]	Opens the full calculation dialog (p. 27).
[Animate]	Starts an animation in the Color display (p. 29) from the current time point. The animation can be stopped by pressing the same button.
[Quit]	Quits (p. 3) the MCE program.

Options menu

The [Options] menu in the main window includes buttons [MNE options], [Preprocessing], and [Batch tasks] buttons. The [MNE options] button opens the MNE Options window.

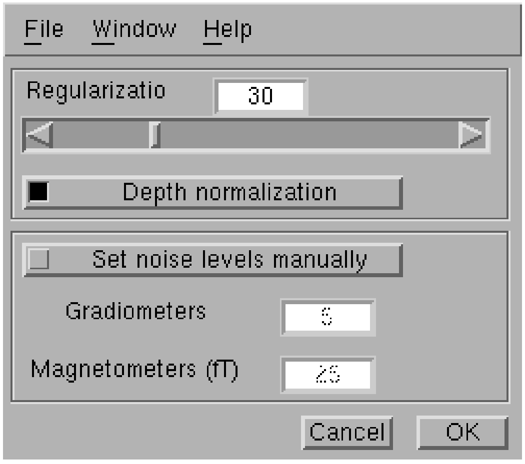


Figure 12 Minimum norm estimate options dialog

The [Regularization] slider and text field select and show the number of singular values of the data used in the estimate. If the noise level in the measurement is low, increase the value to correctly estimate more complex source distributions. If the noise level is high, decrease its effect by decreasing the value. The default value (30) is usually reasonable for averaged evoked responses.

Keeping the [Depth normalization] button pressed compensates for the tendency of the estimate to produce too superficial sources.

The Elekta Neuromag™ and Vectorview™ have both magnetometer and gradiometer sensors. In the estimation, the signals are analyzed in relation to the noise level. The default values (5 fT/cm for gradiometers, 25 fT for magnetometers) are reasonable in evoked response measurements, but if for some reason their relative noise level changes, you can modify the values in this dialog. Press the [Set noise levels manually] button and change the values in the text fields.

If the options are changed, the windows displaying the previous estimate are closed.

Warning: If the regularization parameters are changed from the default ones, the new values must be validated using known data.

12.3 Pre-processing dialog

The pre-processing dialog is opened by pressing the [Preprocessing] button in the Options menu or automatically when you select a new data file.

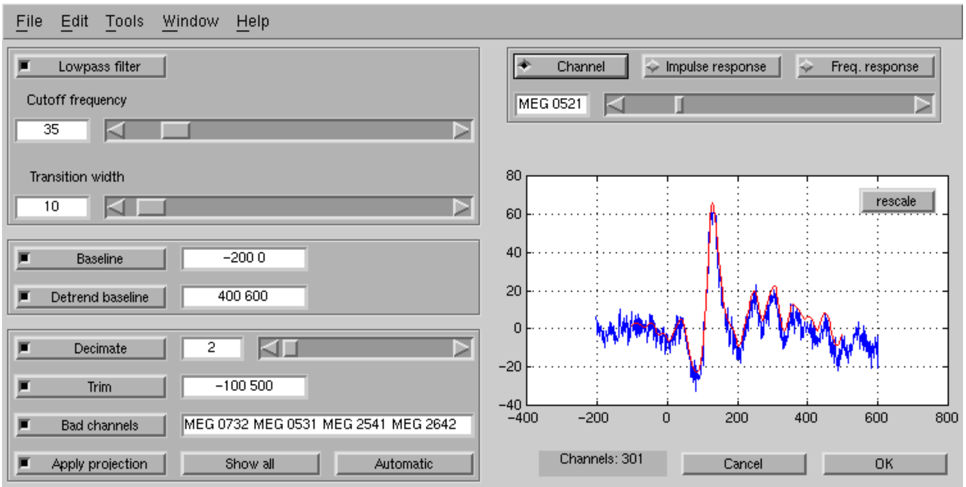


Figure 13 The pre-processing dialog

The left side of the window shows controls that you can use to pre-process the data. With the *filter frame* you can low-pass filter the data, with the *baseline frame* you can compensate for the DC level and slow drifts. With the *projection frame* you can down-sample the data and select the interesting period for the calculation. and set bad channels and noise projection.

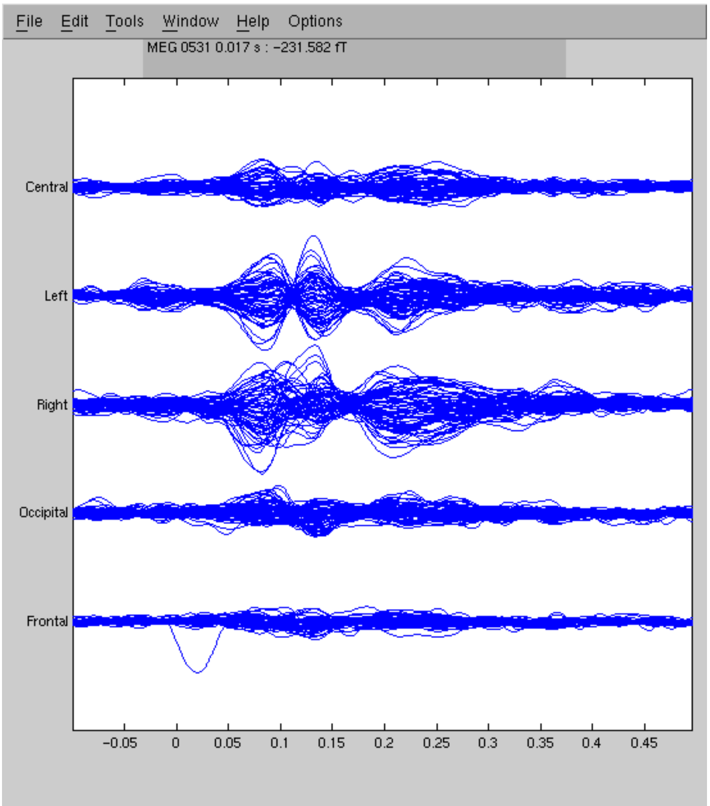
The right side of the window shows a preview of the original data (blue) and processed data (blue). You can zoom into the display with the left mouse button. The *preview frame* lets you either select the channel or to view the amplitude or frequency response of the filter. The latter can be used to check for a good down-sampling ration; the [Rescale] button reverts to automatic scaling.

See chapter "Selecting the data file and pre-processing" on page 4 for additional instructions using this dialog.

Table 4 Controls in the Pre-processing dialog

Filter frame	The [Lowpass filter] toggle selects the filter. You can select the cutoff frequency or transition width with the corresponding text fields or sliders.The values are in Hz. Use the [Freq. response] and [Impulse response] buttons to see the effect of the filter. **Units: Hz**
Baseline frame	The [Baseline] toggle and the corresponding text field select the baseline period used to remove the DC offset and in automatic selection of the bad channels (p. 4). The [Detrend baseline] toggle and the corresponding text field select the other baseline used for removing slow drifts (p. 4). **Units: ms**
[Decimate]	The toggle button and text field or slider select the down-sampling ratio. See section "Decreasing the computing time and file sizes" on page 5. **Units: samples**
[Trim]	The toggle button and text field select the analysis period. **Units: ms**
[Bad channels]	The toggle button and text field set the bad channels. Write the channel numbers to the text field with format 'MEG #### #### #### ####'
[Apply projection]	If the toggle button is set, the noise projection defined in the data file is applied to the data and calculations.
[Show all]	Opens the MEG data -dialog (p. 26).
[Automatic]	The button resets the projection and bad channels to default values. See "Bad channels and projections" on page 6.
Preview frame	The buttons let you select either a single channel or filter properties in the preview plot
Preview plot	Shows the selected information; original data in red and processed data in blue. Left mouse button zooms in the image, the [rescale] button reverts to automatic scaling. **X-axis units: ms** in Channel and Impulse response mode, **Hz** in freq. response mode. **Y-axis units: fT** for magnetometers, **fT/cm** for gradiometers.
[Cancel]	Closes the window
[OK]	Applies the new values and closes the window

12.4 MEG data dialog



The *MEG data* dialog is opened with the [Show all] button of the Pre-processing dialog (p. 23). It shows waveforms of all the channels overlaid based location. Left-clicking zooms in the image, right-clicking shows the maximum amplitude and channel in the selected time and location. The commands in the [Options] menu (p. 26) can be used to set the scale and layout.

Table 5 Commands in the Options menu of the MEG data dialog

[Channels]	Opens Meg channels window for selecting the shown channels and scaling
[Selections]	Opens Channel selection window for selecting pre-defined layouts
[Groups]	Opens Channel group window for selecting grouping of channels in the layout
[Remove mean]	Removes the mean value of the waveforms

12.5 Full calculation dialog

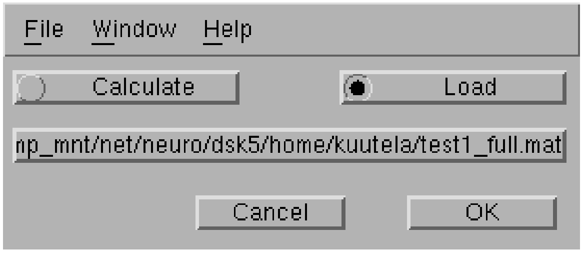


Figure 14 The full calculation dialog

The *full calculation dialog* is opened by pressing the [Full] button in the Main window (p. 22).

This window is used to calculate (p. 11) or load (p. 12) the minimum norm estimates of a whole response. The calculation of a new estimate will take will take some time, typically a second or two for each time point in the response.

Table 6 Controls in the full calculation dialog

[Calculate]	This button should be pressed if you want to calculate a new estimate
[Load]	This button should be pressed if you want to load an old estimate
[Select file ...]	Use the large button to select the file name of the saved or loaded estimate. If a fif-file is selected, this button shows the default name of the batch file.

12.6 Batch jobs window

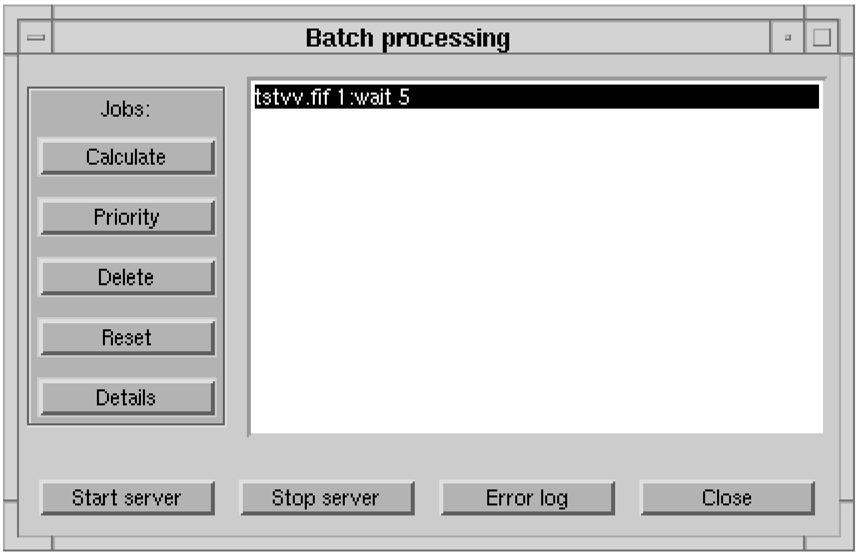


Figure 15 The batch jobs window

This window controls the calculation of the estimates. The list shows current batch jobs and their states. The preferred way to start a calculating all the jobs, press the [Start server] button. This will be done in the background and you can use the program to add new jobs or view the results, or even log out and free the terminal for others. You can update the list by clicking it with mouse button.

You can also select one particular job and press the [Calculate] button. to see the progress bars, but then you can not use the program for other tasks and you must not log out before the calculation is finished. See "Calculating the estimates" on page 11.

Table 7 Controls in the batch jobs window

[Calculation]	Start calculating the selected job. You will see progress of the calculation, but you can not use the program
[Priority]	Set the priority of the selected job
[Delete]	Delete the selected job
[Reset]	Reset the job after an error or stop calculating it
[Details]	Show details of the selected job
[Start server]	Start a calculation in the background
[Stop server]	Stop the calculation in the background
[Close]	Close the window

12.7 Color display

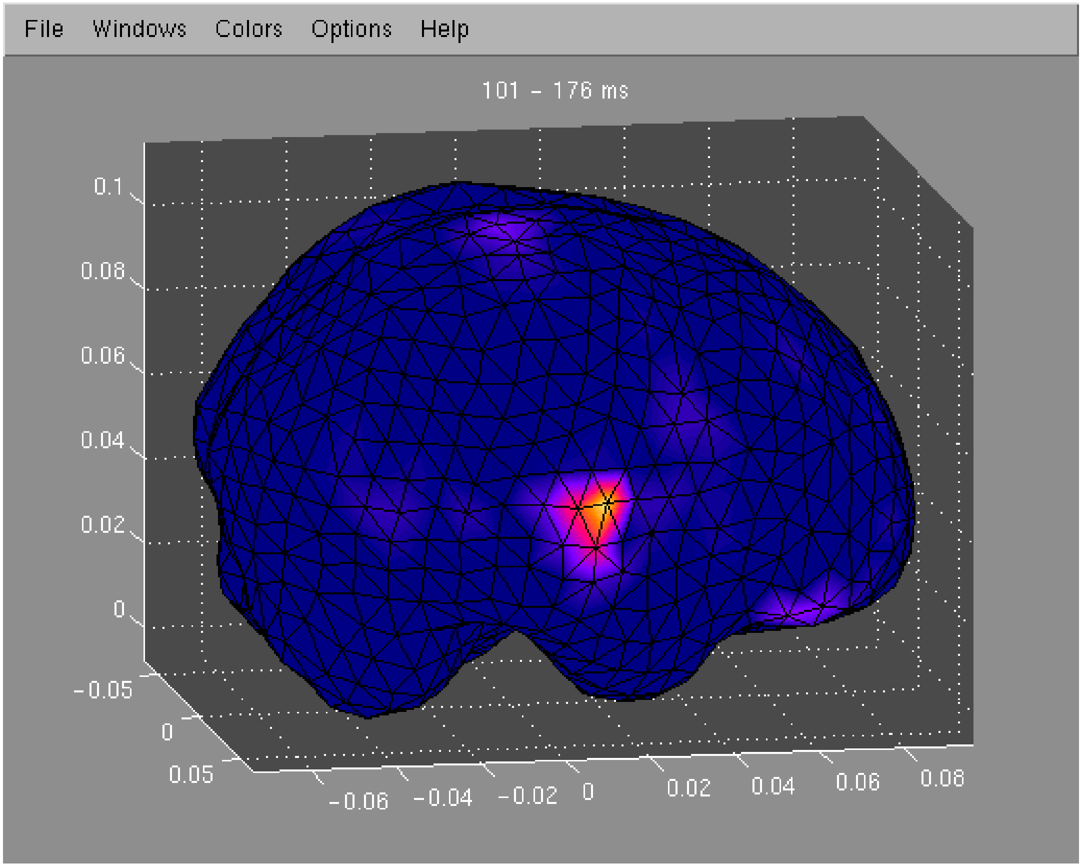


Figure 16 Color display of the estimate

The color display is opened by selecting [Color display] in the Windows menu (p. 21).

The color display shows the estimated source distribution projected to the surface of the brain. The projection is done along the radius of the sphere model. If a time period is selected, the average activity during the period is shown.

You can rotate the image by moving the mouse while holding down the left button. The color scale can be viewed and changed with the Color scale window (p. 33). The coloring of the window can be changed with the [Colors] menu.

You can select a region of interest (ROI, "Region of interest" on page 14) by pressing down the right mouse button and dragging over the active area. The color display will show the selected activity only. You can toggle between showing the selected or all activity by using [Selected] button in the [Options] menu or by pressing space bar while the window is active.

You can view the location of the peak activity by selecting [Max] in the [Options] menu

12.8 Arrow display

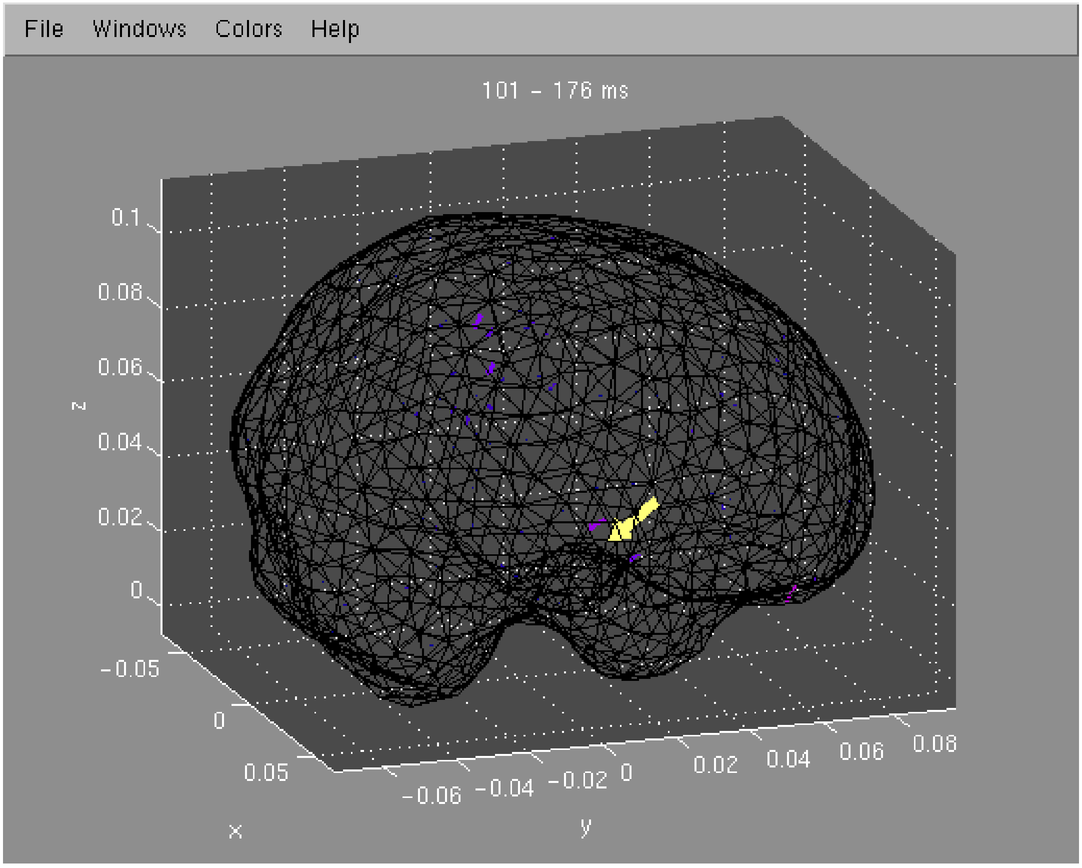


Figure 17 Arrow display of the estimate

The arrow display is opened by selecting [Arrow display] in the Windows menu (p. 21).

The arrow display shows the 3-dimensional estimated source locations and orientations. If a time period is selected, the average activity during the period is shown.

You can toggle between showing the selected or all activity by using [Selected] button in the [Options] menu or by pressing space bar while the window is active.

You can rotate the image by moving the mouse while holding down the left button. The arrow length and colors are automatically scaled and the colors are **not** comparable with the Color scale window (p. 33). The coloring of the arrows can be changed with the [Colors] menu.

12.9 Amplitude window

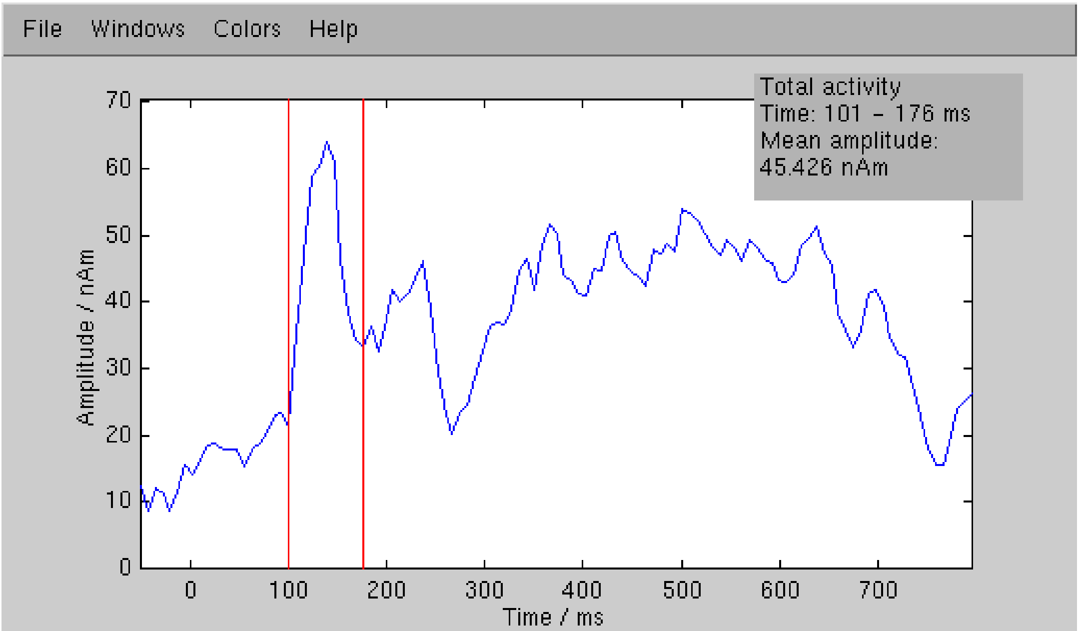


Figure 18 The amplitude window with total activity

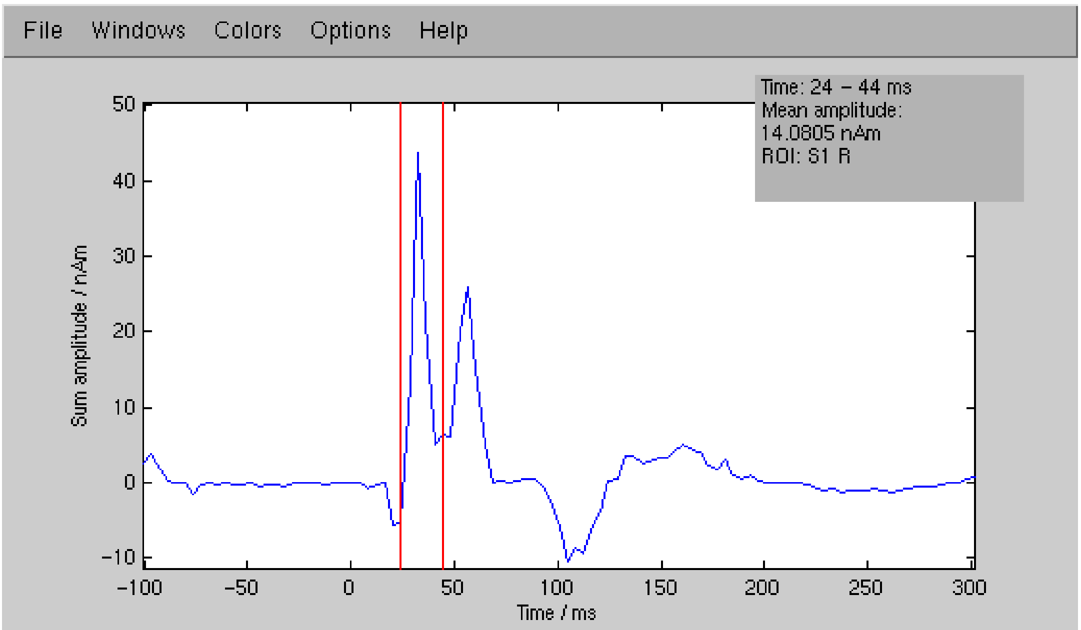


Figure 19 The amplitude window with an oriented ROI

The amplitude window is opened by selecting [Amplitude] in the Windows menu (p. 21).

The amplitude window shows the activity of the selected ROI (p. 14) during the whole response. You can also use it to select a time point or time range (p. 13).

To select a time point, use the left mouse button. To select a time range, drag with the right mouse button.

The text box shows the selected ROI, time range and the average amplitude during the time range.

You can change the X- and Y-axis scales, or toggle using the orientation of the ROI, with the amplitude scale window (p. 32).

The [Option] menu includes the button [Show predicted fields], which shows the measured and predicted MEG waveforms with the XPlotter program (p. 16).

12.10 Amplitude scale window

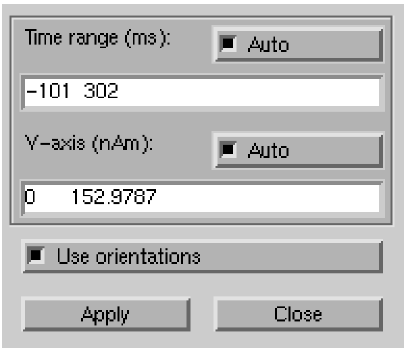


Figure 20 Amplitude scale window

With the amplitude scale window you can set the scale of the X- and Y-axes of the amplitude window (p. 31). The [Auto] toggle button selects automatic or manual scaling. In the manual scaling mode you can define the minimum and maximum values in the corresponding text field. The X-axis units are ms and Y-axis units nAm.

The [Use orientations] button selects whether oriented or non-oriented ROIs (p. 14) are used.

12.11 Color scale window

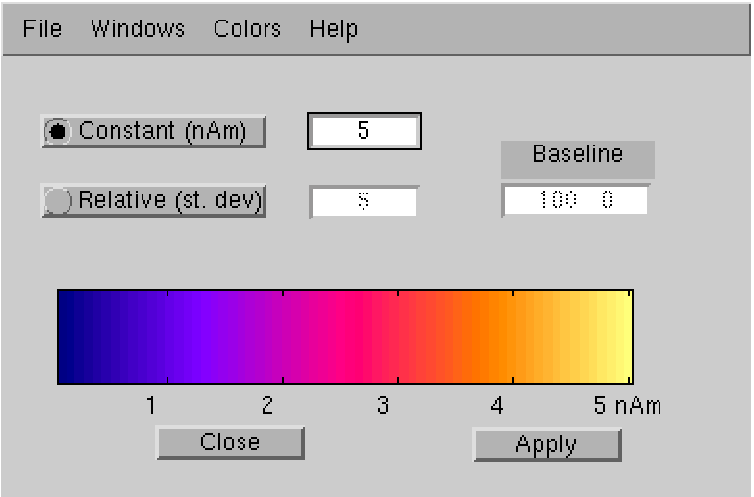


Figure 21 The color scale window

The color scale window is opened by selecting [Color scale] in the Windows menu (p. 21).

You can adjust the color scale of the Color display (p. 29) using the color scale window.

Constant color mode

By pressing the [Constant] button you can select the constant color scale, where the colors a selected according the absolute value of the estimate. The maximum in nAm can be entered in the field.

Relative color mode

By pressing the [Relative] button you can select the relative color scale, where the colors a selected according the average strength of the activity during the baseline time. The maximum as multiples of the standard deviation can be entered in the field to the right.

Enter the start and end time of the baseline [Baseline] field in milliseconds separated by a space. If the baseline is not completely within the time span of the measured response, the overlapping part is used.

If no batch calculation is loaded or if the baseline range does not overlap the response, constant color mode is used.

Things to remember

Remember that the Arrow display (p. 30) has different color scale and check that you are using the same color map (p. 21) in different windows.

Remember also, that because the estimation method tries to minimize the current, the absolute scale of the estimate is very likely smaller than that of the real current. However, the relative strengths at different time points or measurements should be reasonable.

12.12 Region of interest window

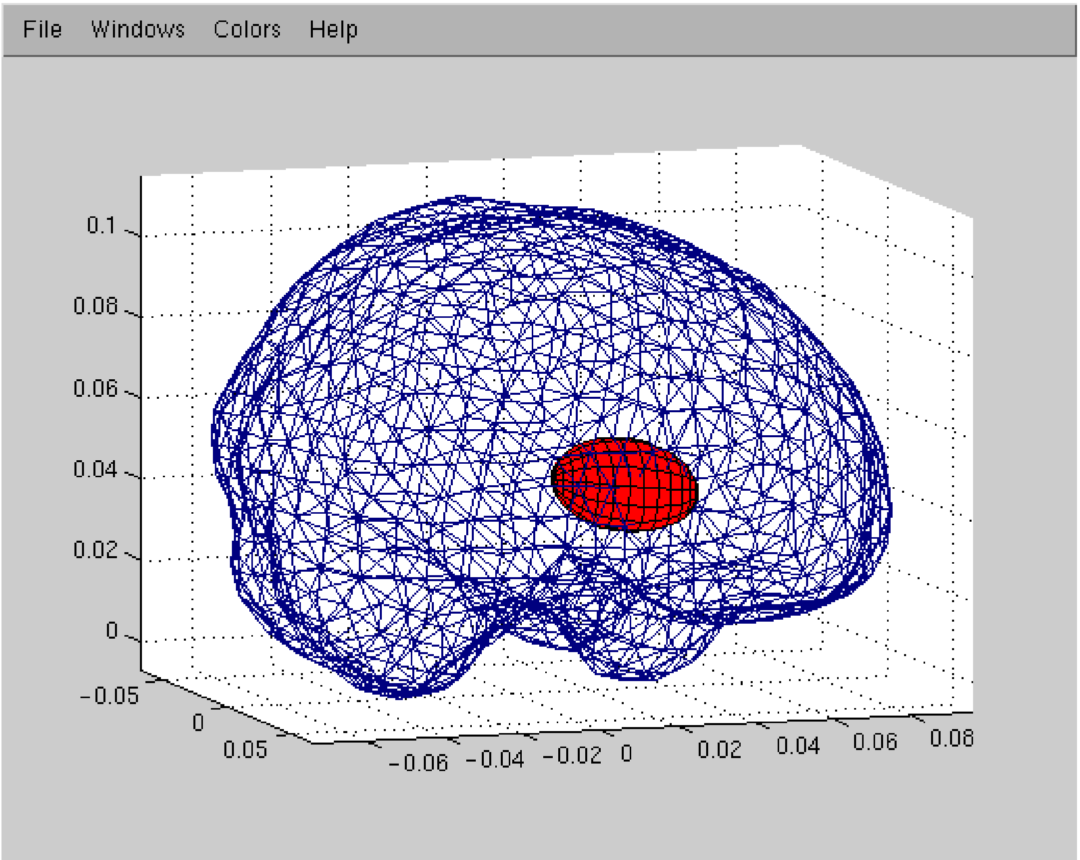


Figure 22 The region of interest

The region of interest window is opened by selecting [Region of Interest] in the Windows menu (p. 21). The currently selected region of interest (ROI) (p. 14) is shown in this display. You can rotate the image by moving the mouse while holding down the left button.

12.13 ROI database window

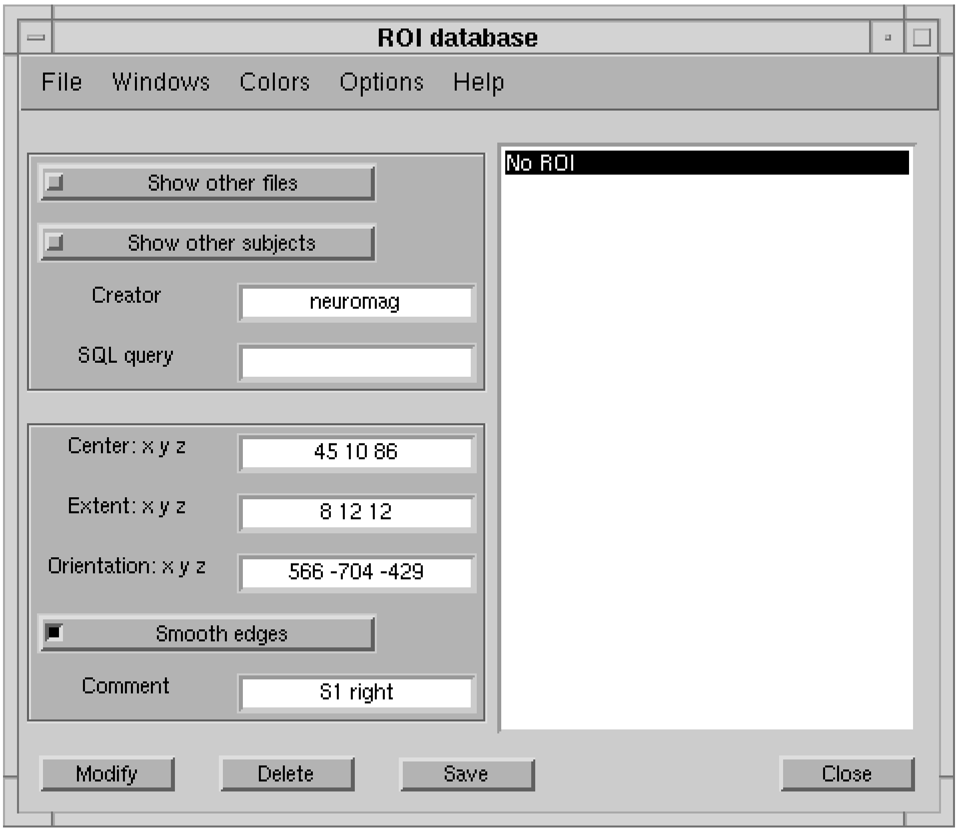


Figure 23 The ROI database

The ROI database window is opened by selecting [ROI database] in the Windows menu (p. 21).

The ROI database window is your contains your interface to the database of previously selected brain areas, ROIs (p. 14).

The controls to search ROIs is in the upper left corner. The list of found ROIs is on the right side. The currently selected ROI is shown on the lower left side.

ROI search

Table 8 Controls in the upper left corner

[Show other files]	Press this button if you want to see the ROIs from different measurements
[Show other point sets]	Press this button if you want to see the ROIs from different subjects having different point sets
[Show other users]	Press this button if you want to see the ROIs created by your colleagues
[SQL query field]	On this field you can have write constraints in using SQL language (p. 37)

ROI list

The list on the right side shows the ROIs matching your specifications. The comment, the name of the fif-file the selection is based on, and the name of the creator are shown.

Select a ROI by pressing the left mouse button on the correct line. The `No ROI` line allows you to see the total activity in the Amplitude window (p. 31).

Current ROI

Table 9 Controls in the lower left corner

[Center]	The center of the ROI in millimeters. The values can not be changed unless [Modify] button is pressed.
[Extent]	The extent of the ROI in millimeters. Only the extents along the X, Y, and Z coordinate axes are shown, although the ROI selected from the Color display (p. 29) can be oblique. The values can not be changed unless [Modify] button is pressed.
[Orientation]	The orientation of the ROI (p. 14). The units of the values do not matter. The values can not be changed unless [Modify] button is pressed.
[Smooth edges]	When selected, a smooth weighting function is used. When unselected, hard edges are used.
[Comment]	The comment used as the name of the ROI

Other controls

Table 10 Controls in the bottom row

[Modify]	Press this button to modify the ROI center and extents or to create the ROI by hand. Only ROIs with main axes coinciding with the X, Y, and > axes can be specified.
[Delete]	Delete the selected ROI. You can delete only the ROIs you have created yourself.
[Save]	Save the current ROI in the database
[Close]	Close the window

SQL database

All the ROI queries are done from an database server using SQL query language. Some examples how to refine your queries:

- `x<0`
- `x<0 AND y>30`
- `fiffile LIKE "rpsef%"`

[Options] menu

The selected ROI can be exported to a file with the [Export new file] button. The [Append] button adds the selected ellipsoid to the previously selected output file.

12.14 HTML Creation Dialog

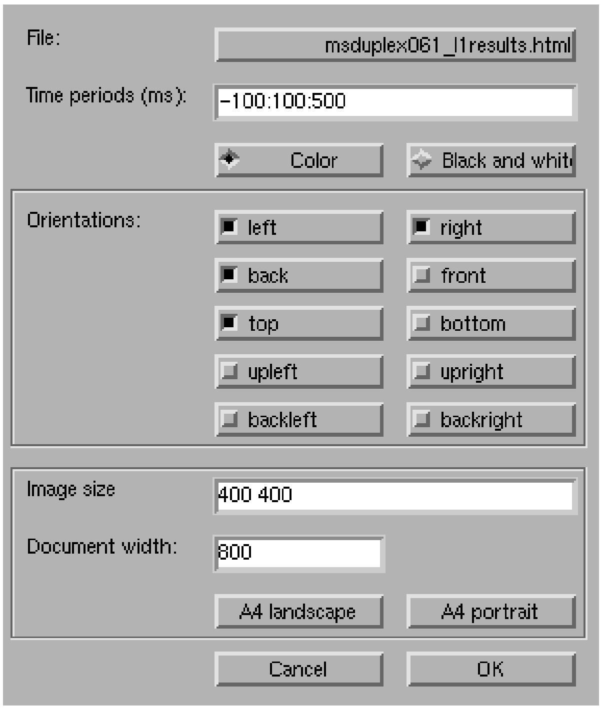


Figure 24 The HTML Creation Dialog

You can open the HTML Creation Dialog from the [File] menu. After selecting appropriate parameters, press OK. The application closes the open files and creates the HTML file.

Table 11 Controls in the HTML Creation Dialog

[File]	Select the output file name. The PNG picture files will be created with the same prefix and different suffixes.

[Time periods]	Select the time periods either with format
	`beginning:length:end`
	or
	`[beginning first second ... end]`
	For example, time periods 100-200 ms and 200-300 ms can be defined as
	`100:100:300`
	or
	`100 200 300`

[Color] [Black and white]	Select the color map used in the figures
[Orientations]	Select different orientations of the brain shown in the HTML document. See Table 2 on page 20.
[Image size]	The size of the produced PNG images
[Document width]	The width of the document. The HTML browser will scale the figures to fit the selected width
[A4 landscape] [A4 portrait]	Shortcuts for default document widths

12.15 Movie Creation Dialog

Figure 25 The Movie Creation Dialog

You can open the Movie Creation Dialog from the [File] menu.

Table 12 Controls in the Movie Creation Dialog

[File]	Select the output file name

[Time points]	Select the time points with format
	`begin:skip:end`
	For example, for a movie from 100 to 300 ms with 10 ms step between frames, select
	`100:10:300`

[Window length]	The length of time period integrated for each frame in the movie
[Orientations]	Select the orientation of the brain in the movie. See Table 2 on page 20.
[Image size]	The pixel size of the produced movie

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